DEPARTMENT OF EDUCATION

Agriculture, Food, and Natural Resources (AFNR) Frameworks 2021

Section 6 – Natural Resources & Environmental Service Systems (NRES) Pathway Frameworks

Introduction

The Minnesota Natural Resource and Environmental Service Systems (NRES) Career Pathway is a combination of two overlapping national AFNR pathways. The Natural Resource Systems (NRS) national AFNR pathway encompasses the study of the management, protection, enhancement and improvement of soil, water, wildlife, forests, and air as natural resources. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application, and management of natural resource systems in AFNR settings. The Environmental Service Systems (ESS) national AFNR pathway encompasses the study of systems, instruments and technology used to monitor and minimize the impact of human activity on environmental systems. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application, and management of environmental service systems in AFNR settings.

Section Contents

Recommended NRES Courses and Pathway Sequence

Students concentrating on the NRES pathway should complete a sequence of at least two courses within the following course offerings based their career goals and interests.

Introductory Courses	Intermediate Courses	Advanced Courses
01 Principles of Ag., Food, and Natural Resources	49 Wildlife, Fisheries, and Ecology Management	13 Agricultural Education, Research, and Development
02 Advanced Principles of Ag., Food, and Natural Resources	50 Advanced Wildlife, Fisheries, and Ecology Management	59 Specialty and Emerging Natural Resource Systems Topics
03 Principles of AFNR Biology (Science-Elective Credit)	51 Water Treatment and Environmental Services	93 Extended/ Summer AFNR Work-Based Learning (SAE) and Leadership (FFA)
04 Advanced Principles of AFNR Biology (Science-Elective Credit)	52 Forestry Science and Management	94 Agricultural Leadership Development
45 Energy and Natural Resources Science	53 Forestry Operations (Simulated WBL: School Farm)	95 Agricultural Career Seminar
46 Advanced Energy and Natural Resources Science	54 Biofuels, Renewable Resources, and Alternative Energy	96 Advanced Agricultural Career Seminar
47 Energy and Natural Resources Ecology (Science-Elective Credit)	55 Minerals, Mining, and Fuels	97 AFNR Work Experience: Immersion SAE (Adv. Internship/Placement, Entrepreneurship, Research)
48 Advanced Energy and Natural Resources Ecology (Science-Elective Credit)	56 Energy and Environmental Engineering	
	57 Outdoor Education and Recreation Management	
	58 Environmental Science Issues and Policy	

Recommended Work-Based Learning (WBL) and SAEs within NRES

A Supervised Agricultural Experience (SAE) is a student-led, instructor-supervised, Work-Based Learning (WBL) experience that results in measurable outcomes within a predefined, agreed upon set of AFNR Technical Standards and Career Ready Practices aligned to a Career Plan of study. SAE teaches technical skills and knowledge within the psychomotor domain of learning. SAE includes both experiential learning (i.e., pre-WBL) and WBL (federally defined as sustained interactions with industry or community professionals in real workplace settings, to the extent practicable, or simulated environments, at an educational institution that foster in-depth, firsthand engagement with the tasks required in a given career field, that are aligned to curriculum and instruction; Sec. 3 [20 U.S.C. 2302] 55).

SAE/WBL is a required component of an AFNR program, first established in the Smith-Hughes Act (1917) and reinforced in each of the federal Perkins Career and Technical Education (CTE) Acts (1984 – I; 1990 – II; 1998 – III; 2006 – IV; 2018 – V, Public Law No. 115-224). Minnesota also requires WBL/SAE as a component of CTE Program Approval (Minn. R. 3505). Table 1 has example SAE opportunities within this pathway, as defined by the National Council for AFNR Education, Perkins V legislation, and the Minnesota Department of Education.

Table 1. Examples of WBL/SAE Curricula and Programs within NRES

SAE Program Area	Examples, Non-Exhaustive
Experiential Learning (Foundational SAE; Pre-WBL)	• Career exploration • Review of the hunting industry in your area • Job shadowing at a local game farm • Ag issues in the outdoor recreational industry • State parks and recreational tourism business workshops
Internship (Placement SAE; Immersion WBL)	• Working at a recreational wildlife farm • Working for the state department of natural resources • Working for a wildlife management specialist in habitats • Working for MN DNR in Wildlife/Tree Planting/Smoke Chaser
Apprenticeship (Placement SAE; Immersion WBL)	• More than 450 hours in an internship, combined with coursework • Contact the Minnesota Department of Education (MDE) for support
Entrepreneurship (Entrepreneurship SAE; Immersion WBL)	• Starting a wildlife management consulting firm • Forest management consulting • Food plot and trail installation/consultation • Creating and selling fishing lures and decoys
Research (Research SAE; Immersion WBL)	• Economic value in rural communities from hunting • Trail cam/camera trap population surveys and research • Wildlife disease and population studies
School-Based Enterprise (School-Based SAE; Simulated WBL)	• Community Supported Ag/School Farm Operations SBE WBL • Aquaculture Operations SBE WBL • Forest/Natural Resources Operations SBE WBL
FFA Work-Based Learning and SAE Proficiency Award Areas	• Environmental Science and Natural Resources Management • Forest Management and Products • Outdoor Recreation

Recommended Social-Emotional Learning (SEL) and FFA Opportunities within NRES

The National FFA Organization (FFA) is a student-led, instructor-supervised, Career and Technical Student Organization (CTSO) that results in measurable outcomes within a predefined, agreed upon set of AFNR Social-Emotional Standards and Career Ready Practices aligned to a Career Plan of study. FFA teaches social-emotional and leadership skills and knowledge within the affective domain of learning. FFA includes programs that provide essential employability skills such as critical thinking, consensus building, communication, teamwork, and leadership. FFA was founded in 1928 and is federally defined as intracurricular (i.e., within the curriculum; cf. extracurricular: external, co-curricular: alongside) and an integral part (i.e., necessary to form the whole) of School-Based AFNR Education (Public Law No. 116-7).

Leadership/FFA is a required component of an AFNR program, formalized in the FFA Federal Charter in 1950 (Public Law No. 116-7) and reinforced in federal Perkins CTE Acts (1984 – I; 1990 – II; 1998 – III; 2006 – IV; 2018 – V, Public Law No. 115-224). Minnesota also requires leadership/FFA as a component of CTE Program Approval (Minn. R. 3505). Table 2 has example FFA opportunities with this pathway, as defined by the National Council for AFNR Education, Perkins V legislation, Department of Education, and the Minnesota FFA Association.

Table 2. Examples of SEL/FFA Curricula and Programs within NRES

FFA Program Area	Examples, Non-Exhaustive
Student Development Programs (Growing Leaders)	● Agriscience fair or SAE open house ● Outdoor recreation activities
Community Development/ Service (Building Communities)	● Veteran hunting/fishing program ● Roadside/trail/streambank clean-up ● Recycling/composting program ● Water quality monitoring program
Literacy, Advocacy, and Safety (Strengthening Agriculture)	● Firearms safety ● ATV/snowmobile safety ● Wildland firefighting S130/S190 ● Alternative energy education ● Camping and fishing trips ● Trapper education program
Conferences, Conventions, and Banquets	● InTENse ● Wildlife conservation organization events (e.g., Ducks Unlimited, Pheasants Forever, Wild Turkey Federation, Deer Hunters) ● Environmental organization events (e.g., Audobon Chapters, Land Stewardship Project, Nature Conservancy)
Career Development Events (CDE)	● Environmental and Natural Resources ● Fish and Wildlife Management ● Forestry ● Soils
Leadership Development Events (LDE)	● Agricultural Issues Forum ● Marketing Plan ● Prepared Public Speaking ● Extemporaneous Speaking

MN.NRES.01: Ecology and Resource Management

Plan and conduct natural resource management activities that apply logical, reasoned, and scientifically based solutions to natural resource issues and goals.

Performance Indicator MN.NRES.01.01

Classify different types of natural resources in order to enable protection, conservation, enhancement, and management in a particular geographical region.

Introductory Course Benchmarks	Intermediate Course Benchmarks	Advanced Course Benchmarks
NRES.01.01.01.a. Research and examine the characteristics used to identify trees and woody plants.	NRES.01.01.01.b. Apply identification techniques to determine the species of a tree or woody plant.	NRES.01.01.01.c. Evaluate the species of trees present to assess the health of an ecosystem (e.g., presence of native versus invasive species, biodiversity).
NRES.01.01.02.a. Research and examine the characteristics used to identify herbaceous plants.	NRES.01.01.02.b. Apply identification techniques to determine the species of an herbaceous plant.	NRES.01.01.02.c. Evaluate the species of herbaceous plants present to assess the health of an ecosystem (e.g., presence of native versus invasive plants, biodiversity).
NRES.01.01.03.a. Research and examine the characteristics used to identify wildlife and insects.	NRES.01.01.03.b. Apply identification techniques to determine the species of wildlife or insect.	NRES.01.01.03.c. Evaluate the species of wildlife and insects present to assess the health of an ecosystem.
NRES.01.01.04.a. Research and examine the characteristics used to identify aquatic species.	NRES.01.01.04.b. Apply identification techniques to determine the species of an aquatic organism.	NRES.01.01.04.c. E valuate the aquatic species present to assess the health of an ecosystem.
NRES.01.01.05.a. Research and examine the characteristics used to identify non-living resources (e.g., soil types, climate, geography).	NRES.01.01.05.b. Apply identification techniques to determine the types of non-living resources in an area.	NRES.01.01.05.c. Evaluate the non-living resources present in an area to determine the best practices for improving, enhancing, and protecting an ecosystem.
NRES.01.01.06.a. Research the purpose and value of resource inventories and population studies.	NRES.01.01.06.b. Apply procedures for conducting resource inventories and population studies.	NRES.01.01.06.c. Conduct an assessment of the resource inventories or population in a given area.

MN.NRES.01: Ecology and Resource Management, Continued

Plan and conduct natural resource management activities that apply logical, reasoned, and scientifically based solutions to natural resource issues and goals.

Performance Indicator MN.NRES.01.02

Apply ecological concepts and principles to atmospheric natural resource systems.

Introductory Course Benchmarks	Intermediate Course Benchmarks	Advanced Course Benchmarks
NRES.01.02.01.a. Classify different kinds of biogeochemical cycles and the role they play in natural resources systems.	NRES.01.02.01.b. Assess the role that the atmosphere plays in the regulation of biogeochemical cycles.	NRES.01.02.01.c. Evaluate and make recommendations to lessen the impact of human activity on the ability of the atmosphere to regulate biogeochemical cycles.
NRES.01.02.02.a. Research and summarize how climate factors influence natural resource systems.	NRES.01.02.02.b. Analyze the impact that climate has on natural resources and debate how this impact has changed due to human activity.	NRES.01.02.02.c. Assess the primary causes of climate change and design strategies to lessen its impact on natural resource systems.

Performance Indicator MN.NRES.01.03

Apply ecological concepts and principles to aquatic natural resource systems.

Introductory Course Benchmarks	Intermediate Course Benchmarks	Advanced Course Benchmarks
NRES.01.03.01.a. Summarize the roles and properties of watersheds.	NRES.01.03.01.b. Assess the function of watersheds and their effect on natural resources.	NRES.01.03.01.c. Evaluate and defend the importance of watersheds to ecosystem function.
NRES.01.03.02.a. Examine and describe the importance of groundwater and surface water to natural resources.	NRES.01.03.02.b. Analyze how different classifications of ground and surface water affect ecosystem function.	NRES.01.03.02.c. Devise and apply strategies to manage, protect, enhance, or improve sources of groundwater or surface water based on its properties.
NRES.01.03.03.a. Compare and contrast riparian zones and riparian buffers based on their function.	NRES.01.03.03.b. Assess techniques used in the creation, enhancement, and management of riparian zones and riparian buffers.	NRES.01.03.03.c. Devise and apply strategies for the creation, enhancement, and management of riparian zones and riparian buffers.

MN.NRES.01: Ecology and Resource Management, Continued

Plan and conduct natural resource management activities that apply logical, reasoned, and scientifically based solutions to natural resource issues and goals.

Performance Indicator MN.NRES.01.04

Apply ecological concepts and principles to terrestrial natural resource systems.

Introductory Course Benchmarks	Intermediate Course Benchmarks	Advanced Course Benchmarks
NRES.01.04.01.a. Research and describe the stages of ecological succession.	NRES.01.04.01.b. Analyze and summarize examples of stages of succession.	NRES.01.04.01.c. Evaluate the stages of succession present in an ecosystem and predict which species will become more prevalent through future stages of succession.
NRES.01.04.02.a. Compare, and contrast, the impact of habitat disturbances and habitat resilience.	NRES.01.04.02.b. Analyze and summarize examples of habitat disturbances and habitat resilience.	NRES.01.04.02.c. Interpret signs of habitat disturbances and resilience in an ecosystem and use these signs to assess the health of an ecosystem.
NRES.01.04.03.a. Compare, and contrast, techniques associated with sustainable forestry (e.g., timber stand improvement, diversity improvement, reforestation).	NRES.01.04.03.b. Analyze a forest in order to determine which forestry techniques would improve that habitat.	NRES.01.04.03.c. Devise a forest management plan that improves the habitat while sustainably maximizing the amount of timber that can be harvested.
NRES.01.04.04.a. Compare, and contrast, techniques associated with soil management (e.g., soil survey and interpretation, erosion control).	NRES.01.04.04.b. Analyze a plot of land in order to determine which soil management techniques would be most applicable.	NRES.01.04.04.c. Devise a soil management plan to minimize erosion and maximize biodiversity, plant productivity, and the formation of topsoil.

MN.NRES.01: Ecology and Resource Management, Continued

Plan and conduct natural resource management activities that apply logical, reasoned, and scientifically based solutions to natural resource issues and goals.

Performance Indicator MN.NRES.01.05

Apply ecological concepts and principles to living organisms in natural resource systems.

Introductory Course Benchmarks	Intermediate Course Benchmarks	Advanced Course Benchmarks
NRES.01.05.01.a. Differentiate between population ecology, population density, and population dispersion and describe the importance of these concepts to natural resource systems.	NRES.01.05.01.b. Analyze the factors that influence population density and population dispersion in natural resource systems.	NRES.01.05.01.c. Create a management plan for a population of a species in an ecosystem given its population ecology, population density, and population dispersion in natural resource systems.
NRES.01.05.02.a. Research and summarize examples of invasive species.	NRES.01.05.02.b. Analyze factors that influence the establishment and spread of invasive species and determine the appropriate steps to prevent or minimize the impact of invasive species.	NRES.01.05.02.c. Evaluate the presence and impact of invasive species on natural resources in a given area and devise a plan to prevent, control, or eliminate invasive species from that habitat.

MN.NRES.02: Human Impact on the Environment and Conservation

Analyze the interrelationships between natural resources and humans.

Performance Indicator MN.NRES.02.01

Examine and interpret the purpose, enforcement, impact and effectiveness of laws and agencies related to natural resource management, protection, enhancement, and improvement (e.g., water regulations, game laws, historic preservation laws, environmental policy).

Introductory Course Benchmarks	Intermediate Course Benchmarks	Advanced Course Benchmarks
NRES.02.01.01.a. Distinguish between the types of laws associated with natural resources systems.	NRES.02.01.01.b. Analyze the structure of laws associated with natural resources systems.	NRES.02.01.01.c. Evaluate the impact of laws associated with natural resources systems (e.g., mitigation, water regulations, carbon emissions, game limits, invasive species).
NRES.02.01.02.a. Distinguish between the types of agencies associated with natural resources systems.	NRES.02.01.02.b. Analyze the specific purpose of agencies associated with natural resources systems.	NRES.02.01.02.c. Evaluate the impact and effectiveness of agencies associated with natural resources systems (e.g., regulation of consumption, prevention of damage to natural resources systems, management of ecological interactions).

MN.NRES.02: Human Impact on the Environment and Conservation, Continued

Analyze the interrelationships between natural resources and humans.

Performance Indicator MN.NRES.02.02

Assess the impact of human activities on the availability of natural resources and or environmental service systems.

Introductory Course Benchmarks	Intermediate Course Benchmarks	Advanced Course Benchmarks
NRES.02.02.01.a. Summarize the relationship between natural resources, ecosystems, and human activity.	NRES.02.02.01.b. Assess and explain how different kinds of human activity affect the use and availability of natural resources (e.g., agriculture, industry, transportation).	NRES.02.02.01.c. Evaluate how the availability of natural resources can be improved through changes to human activity.
NRES.02.02.02.a. Categorize the primary causes of extinction of living species due to human activity (e.g., overharvesting, habitat loss, invasive species, pollution).	NRES.02.02.02.b. Assess causes of extinction and describe how those causes related to loss of biodiversity.	NRES.02.02.02.c. Devise a strategy for preventing the loss of species and biodiversity that takes into account the primary causes of species extinction from human activity.
NRES.02.02.03.a. Examine and describe the manner in which modern lifestyles are related to the depletion of natural resources.	NRES.02.02.03.b. Identify solutions to improve the sustainability of modern lifestyles.	NRES.02.02.03.c. Evaluate how modern lifestyles affect resource consumption and energy use and devise a strategy to prevent the complete loss of a natural resource.

MN.NRES.02: Human Impact on the Environment and Conservation, Continued

Analyze the interrelationships between natural resources and humans.

Performance Indicator MN.NRES.02.03

Analyze how modern perceptions of environmental service systems and or natural resource management, protection, enhancement, and improvement change and develop over time.

Introductory Course Benchmarks	Intermediate Course Benchmarks	Advanced Course Benchmarks
NRES.02.03.01.a. Summarize and categorize the different social considerations in regard to the use of natural resources (e.g., public versus private, laws and regulations, economics, green technology).	NRES.02.03.01.b. Analyze how social considerations can affect the use and sustainability of natural resources.	NRES.02.03.01.c. Develop predictions for how the management, protection, enhancement, and improvement of natural resources will evolve through social considerations (e.g., establishment of national parks, public opinion, fishing, reduction of waste and energy consumption).
NRES.02.03.02.a. Research and assess how historical figures played a prominent role in shaping how natural resources are viewed and used today (e.g., Aldo Leopold, Teddy Roosevelt, John Muir, Rachel Carson, Gaylord Nelson).	NRES.02.03.02.b. Examine and describe the relationship between current trends in natural resource systems and historical figures that played a prominent role in shaping how natural resources are viewed and used today.	NRES.02.03.02.c. Anticipate and predict how society's views and use of natural resources will continue to change as a result of historical figures and trends in modern society.
NRES.02.03.03.a. Research how technology has affected the use and views of natural resources.	NRSE.02.03.03.b. Analyze and document how some technological advancements changed how natural resources were used and viewed (e.g., Industrial Revolution, fossil fuels, green technology).	NRES.02.03.03.c. Anticipate and predict how future technological advancements may affect the use and views of natural resources.

MN.NRES.02: Human Impact on the Environment and Conservation, Continued

Analyze the interrelationships between natural resources and humans.

Performance Indicator MN.NRES.02.04

Examine and explain how economics affects the use of natural resources and or environmental service systems.

Introductory Course Benchmarks	Intermediate Course Benchmarks	Advanced Course Benchmarks
NRES.02.04.01.a. Compare and contrast how the economic value of a natural resource affects its availability.	NRES.02.04.01.b. Assess whether economic value increases or decreases the conservation, protection, improvement, and enhancement of natural resources.	NRES.02.04.01.c. Devise a plan to improve the conservation, protection, improvement, and enhancement of natural resources based on economic value and practices.
NRES.02.04.02.a. Research the impact of the use of natural resources on local, state, and national economies (e.g., outdoor recreation, energy production, preservation).	NRES.02.04.02.b. Assess the importance of the use of natural resources on local, state, and national economies.	NRES.02.04.02.c. Anticipate and predict how changes to the availability of natural resources because of human activity may impact a local, state, and national economy.
NRES.02.04.03.a. Compare and contrast the economic impact of green technology and alternative energy.	NRES.02.04.03.b. Analyze and document how the adoption of green technology or alternative energy affected a local, state, or national economy.	NRES.02.04.03.c. Anticipate and predict the economic impact green technology and alternative energy.

MN.NRES.02: Human Impact on the Environment and Conservation, Continued

Analyze the interrelationships between natural resources and humans.

Performance Indicator MN.NRES.02.05

Communicate information to the public regarding topics related to the management, protection, enhancement, and improvement of natural resources.

Introductory Course Benchmarks	Intermediate Course Benchmarks	Advanced Course Benchmarks
NRES.02.05.01.a. Examine and describe ways in which a message regarding natural resources may be communicated to the public through standard media sources (e.g., press, radio, TV, public appearances).	NRES.02.05.01.b. Assess the effectiveness of different methods for communicating natural resource messages.	NRES.02.05.01.c. Devise and implement a strategy for communicating a natural resources message through media.
NRES.02.05.02.a. Research and summarize how social media and the Internet have changed how people perceive and utilize natural resources (e.g., greater awareness of conservation issues, calls to action).	NRES.02.05.02.b. Assess how to communicate a message most effectively about the conservation, management, enhancement, and improvement of natural resources via social media and the internet.	NRES.02.05.02.c. Anticipate and predict how messages about the conservation, management, enhancement, and improvement of natural resources will change because of social media and the internet.
NRES.02.05.03.a. Examine and describe how communication can be used to influence behavior, call people to action, and instill a sense of civic behavior related to the conservation, management, enhancement, and improvement of natural resources.	NRES.02.05.03.b. Analyze and summarize examples of how communication can be used to influence behavior, call people to action, and instill a sense of civic behavior related to the conservation, management, enhancement, and improvement of natural resources.	NRES.02.05.03.c. Create a communication plan to influence the behavior of people, call people to action and instill a sense of civic behavior related to the conservation, management, enhancement, and improvement of natural resources.

MN.NRES.03: Natural Resources Production and Processing

Develop plans to ensure sustainable production and processing of natural resources.

Performance Indicator MN.NRES.03.01

Sustainably produce, harvest, process and use natural resource products (e.g., forest products, wildlife, minerals, fossil fuels, shale oil, alternative energy, recreation, aquatic species).

Introductory Course Benchmarks	Intermediate Course Benchmarks	Advanced Course Benchmarks
NRES.03.01.01.a. Summarize forest harvesting methods.	NRES.03.01.01.b. Assess harvesting methods in regard to their economic value, environmental impact, and other factors.	NRES.03.01.01.c. Develop a forest harvesting plan that ensures economic, environmental, and social sustainability.
NRES.03.01.02.a. Research and describe methods by which wildlife can be sustainably harvested (e.g., controlled harvests, hunting licenses, regulations).	NRES.03.01.02.b. Assess and apply techniques used to harvest wildlife in regard to sustainability, practicality, and other factors.	NRES.03.01.02.c. Develop a method for the sustainable harvest of wildlife species.
NRES.03.01.03.a. Compare and contrast the costs and benefits (e.g., impacts on environment, economic, wildlife) of mineral extraction to a local, state, and national economy.	NRES.03.01.03.b. Assess the economic impact of mineral extraction in regard to the costs and benefits to a local, state, and national economy.	NRES.03.01.03.c. Evaluate methods used to extract and process minerals for economic, environmental, and social sustainability.
NRES.03.01.04.a. Compare and contrast the costs and benefits (e.g., impacts on environment, economic, wildlife) of fossil fuels to a local, state, and national economy.	NRES.03.01.04.b. Assess the economic impact of fossil fuel extraction in regard to the costs and benefits to a local, state, and national economy.	NRES.03.01.04.c. Evaluate methods used to extract and process fossil fuels for economic, environmental, and social sustainability.
NRES.03.01.05.a. Compare and contrast the costs and benefits (e.g., environmental impacts) of shale oil from fracking to a local, state, and national economy.	NRES.03.01.05.b. Assess the economic impact of shale oil extraction (i.e., fracking) in regard to the costs and benefits to a local, state, and national economy.	NRES.03.01.05.c. Evaluate methods used to extract and process shale oil for economic, environmental, and social sustainability.
NRES.03.01.06.a. Compare and contrast the costs and benefits (e.g., environmental impacts) of alternative sources of energy (e.g., hydroelectric, solar, wind, biofuels, geothermal).	NRES.03.01.06.b. Assess and evaluate factors that affect the economic, environmental, and social sustainability in regard to the use of alternative sources of energy.	NRES.03.01.06.c. Assess trends in energy production and consumption in order to predict how the impact of alternative energy will change in the future.

MN.NRES.03: Natural Resources Production and Processing, Continued

Develop plans to ensure sustainable production and processing of natural resources.

Performance Indicator MN.NRES.03.01, Continued

Sustainably produce, harvest, process and use natural resource products (e.g., forest products, wildlife, minerals, fossil fuels, shale oil, alternative energy, recreation, aquatic species).

Introductory Course Benchmarks	Intermediate Course Benchmarks	Advanced Course Benchmarks
NRES.03.01.07.a. Research and summarize how recreational uses of natural resources can be changed to improve sustainability.	NRES.03.01.07.b. Assess different options for improving the sustainability of outdoor recreation based on its impact on natural resources and likelihood of acceptance.	NRES.03.01.07.c. Evaluate an example of outdoor recreation and develop suggestions for how that activity can be made more sustainable in a manner that is acceptable to those who take part in that activity.
NRES.03.01.08.a. Categorize aquatic species used for commercial and recreational purposes.	NRES.03.01.08.b. Analyze and apply techniques used to acquire aquatic species for their environmental, economic, and social sustainability.	NRES.03.01.08.c. Develop recommendations for the sustainable harvest of aquatic species.

Performance Indicator MN.NRES.03.02

Demonstrate mapping skills, tools, and technologies to aid in developing, implementing, and evaluating natural resource management plans.

Introductory Course Benchmarks	Intermediate Course Benchmarks	Advanced Course Benchmarks
NRES.03.02.01.a. Summarize how to use maps and technologies to identify directions and land features, calculate actual distance and determine the elevations of points.	NRES.03.02.01.b. Apply cartographic skills and tools and technologies (e.g., land surveys, geographic coordinate systems) to locate natural resources.	NRES.03.02.01.c. Evaluate the availability of and threats to natural resources using cartographic skills, tools, and technologies (e.g., spread of invasive species, movement of wildlife populations, changes to biodiversity of edge of habitat versus interior).
NRES.03.02.02.a. Summarize how GIS can be used to manage, conserve, improve, and enhance the natural resources of an area.	NRES.03.02.02.b. Analyze an area's resources using GIS technologies.	NRES.03.02.02.c. Use GIS data for a given area to devise a management plan for the management, conservation, improvement, and enhancement of its natural resources.

MN.NRES.04: Natural Resources Safety, Health, and Ethics

Demonstrate responsible management procedures and techniques to protect, maintain, enhance, and improve natural resources.

Performance Indicator MN.NRES.04.01

Demonstrate natural resource protection, maintenance, enhancement, and improvement techniques.

Introductory Course Benchmarks	Intermediate Course Benchmarks	Advanced Course Benchmarks
NRES.04.01.01.a. Identify and categorize different kinds of streams.	NRES.04.01.01.b. Assess and explain indicators of the biological health of a stream.	NRES.04.01.01.c. Create an enhancement plan for a stream.
NRES.04.01.02.a. Identify and categorize characteristics of a healthy forest.	NRES.04.01.02.b. Assess and apply the methods used to improve a forest stand.	NRES.04.01.02.c. Create a timber stand improvement plan for a forest.
NRES.04.01.03.a. Identify and categorize characteristics of a healthy wildlife habitat.	NRES.04.01.03.b. Assess and apply methods of wildlife habitat improvement.	NRES.04.01.03.c. Devise a comprehensive improvement plan for a wildlife habitat.
NRES.04.01.04.a. Identify and categorize characteristics of healthy rangeland.	NRES.04.01.04.b. Assess and apply methods of rangeland improvement.	NRES.04.01.04.c. Evaluate and revise a rangeland management plan.
NRES.04.01.05.a. Identify and categorize characteristics of natural resources that make them desirable for recreational purposes.	NRES.04.01.05.b. Assess and apply management techniques for improving outdoor recreation opportunities.	NRES.04.01.05.c. Evaluate the impact of recreational activities on natural resources and create an improvement plan.
NRES.04.01.06.a. Identify and categorize characteristics of healthy marine and coastal natural resources.	NRES.04.01.06.b. Assess and apply methods to improve marine and coastal natural resources.	NRES.04.01.06.c. Create an improvement plan for marine or coastal natural resources.

MN.NRES.02: Natural Resources Safety, Health, and Ethics, Continued

Demonstrate responsible management procedures and techniques to protect, maintain, enhance, and improve natural resources.

Performance Indicator MN.NRES.04.02

Diagnose plant and wildlife diseases and follow protocols to prevent their spread.

Introductory Course Benchmarks	Intermediate Course Benchmarks	Advanced Course Benchmarks
NRES.04.02.01.a. Classify causes of diseases in plants and the correct authorities to whom some diseases should be reported.	NRES.04.02.01.b. Analyze a plant disease based on its symptoms, identify if the disease needs to be reported to authorities and determine which authorities it should be reported to.	NRES.04.02.01.c. Create a management plan to reduce infection and the spread of plant diseases in natural resource systems.
NRS.04.02.02.a. Classify causes of diseases in wildlife and aquatic species and determine the correct authorities to whom some diseases should be reported.	NRS.04.02.02.b. Analyze a wildlife or aquatic species disease based on its symptoms, identify if the disease needs to be reported to authorities and determine which authorities it should be reported to.	NRS.04.02.02.c. Create a management plan to reduce infection and spread of wildlife or aquatic species diseases in natural resource systems.

Performance Indicator MN.NRES.04.03

Prevent or manage introduction of ecologically harmful species in a particular region.

Introductory Course Benchmarks	Intermediate Course Benchmarks	Advanced Course Benchmarks
NRES.04.03.01.a. Categorize harmful and beneficial insects, as well as signs of insect damage to natural resources.	NRES.04.03.01.b. Analyze signs of insect infestation, identify if it needs to be reported to authorities and determine which authorities it should be reported to.	NRES.04.03.01.c. Create a management plan to reduce spread of harmful insects in natural resource systems.
NRES.04.03.02.a. Identify and classify invasive species common to a particular region.	NRES.04.03.02.b. Analyze signs of the spread of invasive species, identify if it needs to be reported to authorities and determine which authorities it should be reported to.	NRES.04.03.02.c. Create a management plan to reduce spread of harmful invasive species in natural resource systems.
NRES.04.03.03.a. Research and summarize strategies and benefits of preventing the introduction of harmful species to a particular region.	NRES.04.03.03.b. Assess and implement a plan for preventing the spread of harmful species for its effectiveness.	NRES.04.03.03.c. Identify potentially invasive species and devise strategies to prevent ecological damage that would result from the introduction of that species.

MN.NRES.02: Natural Resources Safety, Health, and Ethics, Continued

Demonstrate responsible management procedures and techniques to protect, maintain, enhance, and improve natural resources.

Performance Indicator MN.NRES.04.04

Manage fires in natural resource systems.

Introductory Course Benchmarks	Intermediate Course Benchmarks	Advanced Course Benchmarks
NRES.04.04.01.a. Differentiate between desirable and undesirable fires and research the role fire plays in a healthy ecosystem.	NRES.04.04.01.b. Assess and apply techniques used to fight wildfires, manage prescribed fires, and ensure human safety.	NRES.04.04.01.c. Develop a prevention plan for harmful fires for a particular region.
NRES.04.04.02.a. Research and summarize how fire management techniques have evolved.	NRES.04.04.02.b. Assess the effectiveness of techniques previously and currently used to prevent harmful fires.	NRES.04.04.02.c. Anticipate and predict how fire management techniques will evolve in the future.

MN.NRES.05: Environmental Research

Use analytical procedures and instruments to manage environmental service systems.

Performance Indicator MN.NRES.05.01

Demonstrate natural resource protection, maintenance, enhancement, and improvement techniques.

Introductory Course Benchmarks	Intermediate Course Benchmarks	Advanced Course Benchmarks
NRES.05.01.01.a. Identify sample types and sampling techniques used to collect laboratory and field data.	NRES.05.01.01.b. Determine the appropriate sampling techniques needed to generate data.	NRES.05.01.01.c. Collect and prepare sample measurements using appropriate data collection techniques.
NRES.05.01.02.a. Identify methods of statistical analysis commonly used in research (e.g., mean, standard deviation, standard error, error bars).	NRES.05.01.02.b. Summarize the purpose of statistical analysis methods commonly used in environmental service systems research and explain examples of their use in practice.	NRES.05.01.02.c. Utilize data analysis to identify trends in a data sample and assess the confidence that can be drawn from those conclusions.

Performance Indicator MN.NRES.05.02

Properly utilize scientific instruments in environmental monitoring situations (e.g., laboratory equipment, environmental monitoring instruments).

Introductory Course Benchmarks	Intermediate Course Benchmarks	Advanced Course Benchmarks
NRES.05.02.01.a. Identify basic laboratory equipment and explain their uses.	NRES.05.02.01.b. Demonstrate the proper use and maintenance of basic laboratory equipment.	NRES.05.02.01.c. Calibrate and use laboratory equipment according to standard operating procedures.
NRES.05.02.02.a. Identify basic environmental monitoring instruments and explain their uses.	NRES.05.02.02.b. Demonstrate the proper use and maintenance of environmental monitoring instruments.	NRES.05.02.02.c. Calibrate and use environmental monitoring instruments according to standard operating procedures.

MN.NRES.06: Environmental Policy

Evaluate the impact of public policies and regulations on environmental service system operations.

Performance Indicator MN.NRES.06.01

Interpret and evaluate the impact of laws, agencies, policies, and practices affecting environmental service systems.

Introductory Course Benchmarks	Intermediate Course Benchmarks	Advanced Course Benchmarks
NRES.06.01.01.a. Distinguish between the types of laws associated with environmental service systems.	NRES.06.01.01.b. Analyze the structure of laws associated with environmental service systems.	NRES.06.01.01.c. Evaluate the impact of laws associated with environmental service systems for their impact on wildlife, people, the environment, and the economy.
NRES.06.01.02.a. Distinguish between the types of government agencies (i.e., local, state, and federal) associated with environmental service systems.	NRES.06.01.02.b. Analyze the specific purpose of government agencies associated with environmental service systems.	NRES.06.01.02.c. Evaluate the impact and effectiveness of government agencies (i.e., local, state, and federal) associated with environmental service systems (e.g., regulation of consumption, prevention of damage to natural resources systems, management of ecological interactions).
NRES.06.01.03.a. Research policies, practices, and initiatives common in business and advocacy groups associated with environmental service systems (e.g., zero-waste, LEED-certified, locally grown).	NRES.06.01.03.b. Assess the intent, feasibility and effectiveness of policies, practices, and initiatives common in business and advocacy groups associated with environmental service systems.	NRES.06.01.03.c. Evaluate the impact of policies, practices, and initiatives common in business and advocacy groups associated with environmental service systems on wildlife, people, the environment, and the economy.

MN.NRES.06: Environmental Policy, Continued

Evaluate the impact of public policies and regulations on environmental service system operations.

Performance Indicator MN.NRES.06.02

Compare and contrast the impact of current trends on regulation of environmental service systems (e.g., climate change, population growth, international trade).

Introductory Course Benchmarks	Intermediate Course Benchmarks	Advanced Course Benchmarks
NRES.06.02.01.a. Research and categorize the purpose, implementation, and impact of greenhouse gas emission policies (e.g., cap and-trade, emission offsetting, zero-emissions, carbon-neutrality, carbon sequestration).	NRES.06.02.01.b. Assess the effectiveness and impact of greenhouse gas emissions policies.	NRES.06.02.01.c. Devise new policies for controlling greenhouse gas emissions that reduce atmospheric carbon levels while generating additional economic activity.
NRES.06.02.02.a. Research the impact of environmental service systems regulations on international trade.	NRES.06.02.02.b. Analyze how environmental service systems regulations can both negatively and positively affect international trade.	NRES.06.02.02.c. Interpret and evaluate the impact of specific environmental service regulation policies (e.g., Clean Air Act, EISA, Clean Water Act, Superfund) on international trade.
NRES.06.02.03.a. Examine and summarize the impact that population growth has on environmental service systems.	NRES.06.02.03.b. Analyze the correlation between increased population size and the need for regulation of environmental service systems.	NRES.06.02.03.c. Predict the impact of future population growth on the regulation of environmental service systems and evaluate how changes made today will impact future regulations.
NRES.06.02.04.a. Research current policies related to fracking and shale oil gas.	NRES.06.02.04.b. Assess whether current policies related to fracking and shale oil gas sufficiently address the needs of environmental service systems.	NRES.06.02.04.c. Evaluate current fracking policies and create suggestions for modification of these policies to more thoroughly address the needs related to environmental, economic, and social sustainability.

MN.NRES.06: Environmental Policy, Continued

Evaluate the impact of public policies and regulations on environmental service system operations.

Performance Indicator MN.NRES.06.03

Diagnose plant and wildlife diseases and follow protocols to prevent their spread.

Introductory Course Benchmarks	Intermediate Course Benchmarks	Advanced Course Benchmarks
NRES.06.03.01.a. Research and summarize how the perception and regulation of environmental service systems has changed over time.	NRES.06.03.01.b. Analyze and summarize specific changes to perceptions and regulations of environmental service systems and their impact on reducing the ecological, economical, and sociological impact.	NRES.06.03.01.c. Evaluate the impact of specific historical figures, or organizations, on the perception and regulation of environmental service systems.
NRES.06.03.02.a. Examine how social views and movements (e.g., zero-waste philosophy, carbon footprints, recycling) have affected the implementation and need for regulation of environmental service systems.	NRES.06.03.02.b. Assess the effectiveness of specific social movements related to regulation of environmental service systems.	NRES.06.03.02.c. Research current issues related to modern or future environmental service systems and devise strategies for engaging the public to address these issues through social movements.

MN.NRES.07: Scientific Applications within NRES

Develop proposed solutions to environmental issues, problems and applications using scientific principles of meteorology, soil science, hydrology, microbiology, chemistry, and ecology.

Performance Indicator MN.NRES.07.01

Apply soil science and hydrology principles to environmental service systems.

Introductory Course Benchmarks	Intermediate Course Benchmarks	Advanced Course Benchmarks
NRES.07.01.01.a. Differentiate and distinguish land uses, capability factors and land capability classes.	NRES.07.01.01.b. Use a soil survey to determine the land capability classes for different parcels of land in an area.	NRES.07.01.01.c. Design a master land-use management plan for a given area that utilizes land capability classes in order to minimize erosion and flooding, maximize development, and preservation of topsoil, etc.
NRES.07.01.02.a. Research and describe the process of soil formation through weathering.	NRES.07.01.02.b. Differentiate rock types and relate the chemical composition of mineral matter in soils to the parent material.	NRES.07.01.02.c. Examine and explain how the physical qualities of the soil influence the infiltration and percolation of water.
NRES.07.01.03.a. Examine and explain how the physical qualities of the soil influence the infiltration and percolation of water.	NRES.07.01.03.b. Assess the physical qualities of the soil that determine its potential for filtration of groundwater supplies and likelihood for flooding.	NRES.07.01.03.c. Conduct tests of soil to determine its potential for filtration of groundwater supplies and likelihood for flooding.
NRES.07.01.04.a. Summarize environmental hazards associated with groundwater supplies	NRES.07.01.04.b. Assess the effectiveness of precautions taken to prevent or reduce contamination of groundwater supplies.	NRES.07.01.04.c. Evaluate the methods used in a given example to protect groundwater supplies.
NRES.07.01.05.a. Research and summarize hydrogeology and differentiate between groundwater and surface water.	NRES.07.01.05.b. Analyze how interactions between groundwater and surface water affect flow and availability of water.	NRES.07.01.05.c. Construct explanations and solutions to situations involving the declining availability of water that incorporate groundwater flow equations as well as human activity.
NRES.07.01.06.a. Research and describe how groundwater and surface water interactions affect the existence of wetlands.	NRES.07.01.06.b. Analyze the importance of the roles played by wetlands in regard to water availability, prevention of flooding and other factors.	NRES.07.01.06.c Evaluate and select strategies for wetlands preservation and restoration that maximize services provided by wetlands while taking human concerns into consideration.

MN.NRES.07: Scientific Applications within NRES, Continued

Develop proposed solutions to environmental issues, problems and applications using scientific principles of meteorology, soil science, hydrology, microbiology, chemistry, and ecology.

Performance Indicator MN.NRES.07.02

Apply chemistry principles to environmental service systems.

Introductory Course Benchmarks	Intermediate Course Benchmarks	Advanced Course Benchmarks
NRES.07.02.01.a. Examine and summarize how chemistry affects soil structure and function (e.g., pH, cation-exchange capacity, filtration capability, flooding likelihood).	NRES.07.02.01.b. Analyze the soil chemistry of a sample.	NRES.07.02.01.c. Evaluate a sample's soil chemistry and assess how the results may impact considerations in environmental service systems.
NRES.07.02.02.a. Examine and summarize how chemistry affects water quality and function (e.g., oxygen saturation, pH, biomagnification).	NRES.07.02.02.b. Analyze the water chemistry of a sample.	NRES.07.02.02.c. Evaluate a sample's water chemistry and assess how the results may impact considerations in environmental service systems.
NRES.07.02.03.a. Examine and summarize how chemistry affects air quality and function (e.g., heat retention, formation of smog and acid rain).	NRES.07.02.03.b. Analyze how components of atmospheric chemistry (e.g., air chemical components, heat, moisture) affect air quality.	NRES.07.02.03.c. Assess the impact of atmospheric chemistry on operational decisions in environmental service systems.
NRES.07.02.04.a. Examine and summarize the relationship between water and soil chemistry and the formation of different kinds of wetlands (e.g., fens, peat bogs, potholes).	NRES.07.02.04.b. Assess how different kinds of wetlands are formed based on the different kinds of soil and water chemistry present in each case.	NRES.07.02.04.c. Evaluate the services provided by types of wetlands and predict how different types of wetlands respond to pressures due to human activity.

MN.NRES.07: Scientific Applications within NRES, Continued

Develop proposed solutions to environmental issues, problems and applications using scientific principles of meteorology, soil science, hydrology, microbiology, chemistry, and ecology.

Performance Indicator MN.NRES.07.03

Apply microbiology principles to environmental service systems.

Introductory Course Benchmarks	Intermediate Course Benchmarks	Advanced Course Benchmarks
NRES.07.03.01.a. Describe the microbial biodiversity found in soil and summarize the contribution of microbial biodiversity to the physical and chemical characteristics of soil.	NRES.07.03.01.b. Assess how the activities of microorganisms in soil affect environmental service systems and ecosystem biodiversity.	NRES.07.03.01.c. Evaluate how soil microorganisms in environmental service systems can be used to minimize waste, maximize nutrient cycling, and increase ecosystem biodiversity.
NRES.07.03.02.a. Research and describe how microbial populations in an ecosystem affect carbon cycling.	NRES.07.03.02.b. Analyze the microbial populations present in an area and assess how carbon cycling is affected.	NRES.07.03.02.c. Develop strategies for negating air pollutants based on soil microbial populations (e.g., carbon sequestration and rates of decomposition).
NRES.07.03.03.a. Examine and explain the role that microbes play in wastewater treatment.	NRES.07.03.03.b. Assess the impact of wastewater treatment on environmental service systems.	NRES.07.03.03.c. Evaluate modern uses of microbial wastewater treatment and devise strategies to further reduce the environmental, economic, and social impact of wastewater treatment.
NRES.07.03.04.a. Research the purposes of bioassay tests and describe potential applications for environmental service systems.	NRES.07.03.04.b. Analyze procedures for a bioassay test.	NRES.07.03.04.c. Conduct bioassay tests related to environmental service systems and interpret results.

Develop proposed solutions to environmental issues, problems and applications using scientific principles of meteorology, soil science, hydrology, microbiology, chemistry, and ecology.

Performance Indicator MN.NRES.07.04

Apply ecology principles to environmental service systems.

Introductory Course Benchmarks	Intermediate Course Benchmarks	Advanced Course Benchmarks
NRES.07.04.01.a. Research the role that biodiversity plays in environmental service systems and how biodiversity can be measured.	NRES.07.04.01.b. Calculate the amount of biodiversity in a given area using an appropriate method (e.g., quadrat assessment, transect measurements).	NRES.07.04.01.c. Evaluate the biodiversity of an area and predict the impact of changing the levels of biodiversity on environmental service systems.
NRES.07.04.02.a. Examine and explain the role played by habitats on environmental service systems.	NRES.07.04.02.b. Assess the impact of the current rate of habitat loss on environmental service systems.	NRES.07.04.02.c. Evaluate the importance of habitat to environmental service systems and devise strategies to minimize the future loss of habitats.
NRES.07.04.03.a. Research and explain how carrying capacities relate to environmental service systems (e.g., waste processing, rate or production of pollution, disease).	NRES.07.04.03.b. Assess and describe the impact of a population exceeding its carrying capacity on environmental service systems.	NRES.07.04.03.c. Devise a strategy for monitoring and supporting environmental service systems through management of a species' carrying capacity.
NRES.07.04.04.a. Examine and describe how ecological interactions can be used to assess environmental service systems (i.e., macroinvertebrates or amphibians as bioindicators).	NRES.07.04.04.b. Evaluate the benefits and drawbacks of using bioindicator species in environmental service systems.	NRES.07.04.04.c. Utilize evidence from bioindicator species to detect pollutants in a given area.

MN.NRES.08: Environmental Service Operations

Demonstrate the operation of environmental service systems (e.g., pollution control, water treatment, wastewater treatment, solid waste management, energy conservation).

Performance Indicator MN.NRES.08.01

Use pollution control measures to maintain a safe facility and environment.

Introductory Course Benchmarks	Intermediate Course Benchmarks	Advanced Course Benchmarks
NRES.08.01.01.a. Identify and distinguish types of pollution and distinguish between point source and nonpoint source pollution.	NRES.08.01.01.b. Assess how industrial and nonindustrial pollution has damaged the environment.	NRES.08.01.01.c. Evaluate evidence for a given area for industrial and nonindustrial pollution.
NRES.08.01.02.a. Research ways in which pollution can be managed and prevented and propose solutions to meet the needs of local systems.	NRES.08.01.02.b. Conduct tests to determine the presence and extent of pollution.	NRES.08.01.02.c. Create a plan for pollution remediation, management, or prevention for a given area.
NRES.08.01.03.a. Interpret the conditions necessary for waste to be labeled as hazardous.	NRES.08.01.03.b. Classify examples of pollution as hazardous or nonhazardous.	NRES.08.01.03.c. Construct a plan for handling hazardous waste in given situations.

Performance Indicator MN.NRES.08.02

Manage safe disposal of all categories of solid waste in environmental service systems.

Introductory Course Benchmarks	Intermediate Course Benchmarks	Advanced Course Benchmarks
NRES.08.02.01.a. Compare and contrast different types of solid waste and options for treating solid waste.	NRES.08.02.01.b. Analyze environmental hazards created by different types of solid waste, solid waste accumulation, and solid waste disposal.	NRES.08.02.01.c. Develop a plan for solid waste disposal for a given situation that considers the environmental hazards, economic realities, and social concerns associated with this task.
NRES.08.02.02.a. Examine and describe the components of disposing waste in sanitary landfills.	NRES.08.02.02.b. Analyze and document basic sanitary landfill operating procedures and design.	NRES.08.02.02.c. Evaluate sanitary landfill procedures for environmental, economic, and social sustainability.
NRES.08.02.03.a. Research and summarize the benefits and processes of composting.	NRES.08.02.03.b. Apply scientific principles to explain the benefits and processes of composting.	NRES.08.02.03.c. Evaluate the appropriateness of composting methods in different situations.
NRES.08.02.04.a. Examine and describe the importance and potential impact of recycling.	NRES.08.02.04.b. Analyze and document different recycling methods and classify materials that can be recycled.	NRES.08.02.04.c. Survey and evaluate recycling programs and procedures.

MN.NRES.08: Environmental Service Operations, Continued

Demonstrate the operation of environmental service systems (e.g., pollution control, water treatment, wastewater treatment, solid waste management, energy conservation).

Performance Indicator MN.NRES.08.03

Apply techniques to ensure a safe supply of drinking water and adequate treatment of wastewater according to applicable rules and regulations.

Introductory Course Benchmarks	Intermediate Course Benchmarks	Advanced Course Benchmarks
NRES.08.03.01.a. Categorize chemical and physical properties of drinking water.	NRES.08.03.01.b. Analyze and document all steps in the public drinking water treatment process according to applicable standards.	NRES.08.03.01.c. Evaluate samples of water and the processes necessary to verify that the samples are safe for consumption according to applicable standards.
NRES.08.03.02.a. Research methods commonly used to treat wastewater and septic waste.	NRES.08.03.02.b. Analyze and document the steps necessary to ensure that wastewater and septic waste can be safely released into the environment.	NRES.08.03.02.c. Evaluate examples of wastewater or septic waste for its potential to cause environmental, economic, and social problems.

MN.NRES.08: Environmental Service Operations, Continued

Demonstrate the operation of environmental service systems (e.g., pollution control, water treatment, wastewater treatment, solid waste management, energy conservation).

Performance Indicator MN.NRES.08.04

Compare and contrast the impact of conventional and alternative energy sources on the environment and operation of environmental service systems.

Introductory Course Benchmarks	Intermediate Course Benchmarks	Advanced Course Benchmarks
NRES.08.04.01.a. Research conventional energy sources and list conservation measures to reduce the impact on environmental service systems	NRES.08.04.01.b. Assess the advantages and disadvantages of conventional energy sources in regard to environmental service systems.	NRES.08.04.01.c. Evaluate the impact burning of fossil fuels has on environmental service systems.
NRES.08.04.02.a. Research alternative energy sources and describe the motivations for seeking alternatives to conventional energy sources as they relate to environmental monitoring.	NRES.08.04.02.b. Identify advantages and disadvantages of alternative energy sources as they pertain to environmental service systems.	NRES.08.04.02.c. Evaluate the impact alternative energy sources have on environmental conditions.
NRES.08.04.03.a. Examine the factors that affect energy consumption and describe how these factors are related to environmental monitoring.	NRES.08.04.03.b. Analyze and document the main categories of energy consumption.	NRES.08.04.03.c. Evaluate strategies for reducing energy consumption to determine the most effective course of action based on the needs of environmental service systems.
NRES.08.04.04.a. Research the impact on environmental service systems that occur because of energy consumption.	NRES.08.04.04.b. Analyze and document the most significant impacts that energy consumption has on environmental monitoring.	NRES.08.04.04.c. Devise a strategy for improving future energy consumption in a manner consistent with the intents of environmental service systems.
NRES.08.04.05.a. Examine and explain how energy consumption and the carbon cycle relate to environmental monitoring.	NRES.08.04.05.b. Calculate the impact of the carbon cycle imbalance (due to energy consumption) and assess how this imbalance affects environmental service systems.	NRES.08.04.05.c. Use data from environmental monitoring to evaluate methods for reducing the imbalance in the carbon cycle through changes to energy consumption.
NRES.08.04.06.a. Research and describe the purpose and applications of life cycle assessments to environmental service systems.	NRES.08.04.06.b. Interpret a life cycle assessment and explain how it can be utilized in environmental service systems to assess the potential ecological impact of an energy source.	NRES.08.04.06.c. Conduct a life cycle assessment for a given source of energy and use this assessment to determine the best option for energy in regard to environmental service systems.

MN.NRES.09: NRES Tools and Technology

Use tools, equipment, machinery, and technology common to tasks in environmental service systems.

Performance Indicator MN.NRES.09.01

Use technological and mathematical tools to map land, facilities, and infrastructure for environmental service systems.

Introductory Course Benchmarks	Intermediate Course Benchmarks	Advanced Course Benchmarks
NRES.09.01.01.a. Examine the importance and describe applications of surveying and mapping for environmental service systems.	NRES.09.01.01.b. Apply surveying and mapping principles to a situation involving environmental service systems and identify and explain the use of equipment for surveying and mapping.	NRES.09.01.01.c. Demonstrate surveying and cartographic skills to make site measurements in order to address concerns and needs within an environmental service systems situation.
NRES.09.01.02.a. Research the methods in which GIS can be used in environmental service systems (e.g., tracing of point pollution, control of the spread of invasive species).	NRES.09.01.02.b. Apply GIS skills to a situation specific to environmental service systems.	NRES.09.01.02.c. Interpret and evaluate GIS data to come to a conclusion about a scenario specific to environmental service systems.
NRES.09.01.03.a. Research how advancements in technology (e.g., unmanned aerial vehicles and drones, genetic modification, fracking, alternative energy) have changed environmental service systems.	NRES.09.01.03.b. Analyze and document examples of utilization of breaking technology in environmental service systems.	NRES.09.01.03.c. Evaluate trends in technology and develop predictions about how these advancements will change environmental service systems.

Secondary/Multidisciplinary AFNR Pathways that Align with NRES

A secondary or multidisciplinary AFNR pathway, often integrating standards or cumulating from coursework from the AFNR animal, plant, natural resources, and power systems pathways—encompassing the study of agribusinesses and their management including, but not limited to, record keeping, budget management (cash and credit), business planning, and sales and marketing. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the planning, development, application, and management of agribusiness systems in AFNR settings.

A secondary or multidisciplinary AFNR pathway—often integrating standards or cumulating from coursework from the AFNR animal, plant, and natural resources pathways—encompassing the study of using data and scientific techniques to solve problems concerning living organisms with an emphasis on applications to agriculture, food, and natural resource systems. Students completing a program of study in this pathway will demonstrate competence in the application of principles and techniques for the development, application, and management of biotechnology systems in AFNR settings.